

8.3 Viruses

Name: _____ Class: _____ Date: _____ **Total: 23 marks**

KEY WORDS capsid • envelope • antigenic drift

Objective

Read the viral cycle and its mutation arithmetic.

1 Key knowledge and worked examples

■ The six steps

Attachment → entry → uncoating → replication → assembly → release ✓. Genome + capsid ± envelope; enveloped viruses bud, naked viruses lyse the cell.

■ Worked example: drift and shift

RNA polymerases lack proofreading: $\sim 10^{-5}$ errors per site per replication, $\sim 10,000$ -fold above DNA viruses → antigenic drift; 8 segments reassort → antigenic shift ✓. One virion → $\sim 10^3$ progeny in ~ 6 h.

2 Practice

2.1 List the cycle steps between entry and assembly. [3]

2.2 Distinguish antigenic drift from antigenic shift. [3]

2.3 One virion yields $\sim 10^3$ progeny per ~ 6 -h round – how many after two rounds? [3]

3 Exam-style questions

3.1 A fictional winter outbreak: incubation 1–2 days, attack rates $\sim 20\%$ in offices; a second fictional community outbreak shows incubation 2–3 weeks.

Use the burst arithmetic ($\sim 10^3$ per round, ~ 6 h) to explain why the first virus outruns contact tracing while the second spreads slowly and peaks later. State which genome chemistry predicts yearly vaccine updates and why. [7]

3.2 A fictional antiviral blocks the step where the viral genome and proteins are copied inside the cell; a fictional vaccine presents the surface glycoprotein that docks the virion to the receptor.

Name the two cycle steps targeted. Explain why the vaccine antigen choice makes immunological sense (antibodies meet the outside of the virion first). Explain why enveloped viruses exit without lysing the cell. [7]

Solutions

2.1

- Uncoating, then replication of genome and proteins ✓.

2.2

- Drift: point mutations accumulating (no proofreading); shift: reassortment of segmented genomes between strains ✓.

2.3

- $(10^3)^2 = 10^6$ progeny after 12 h ✓.

3.1

- Each round multiplies by $\sim 10^3$: two rounds (12 h) give 10^6 ; 1–2 days of incubation is only 4–8 rounds ✓.
- Fast cycles $\rightarrow$ many infectious people within a day $\rightarrow$ contact tracing is outrun.
- A 2–3-week incubation (DNA virus such as varicella) spreads slowly and peaks later ✓.
- RNA without proofreading ($\sim 10^{-5}$ /site) $\rightarrow$ drift $\rightarrow$ yearly vaccine updates ✓.

3.2

- Replication (the antiviral) and attachment (the vaccine antigen) ✓.
- Antibodies act outside the cell: the attachment glycoprotein is the surface they can reach before entry.
- Enveloped viruses bud – host membrane flows around the virion, cell stays intact ✓.